What is claimed is:

1. A cell culture system comprising:

a cell culture chamber comprising a surface to which cells adhere;

one or more pumps in fluidic communication with the cell culture chamber, the one or more pumps operably coupled to one or more perfusion fluid reservoirs and configured to pump culture media into and out of the cell culture chamber via an inlet and an outlet disposed on the cell culture chamber;

a processor operably connected to the one or more pumps, the processor configured to operate the one or more pumps on a continuous loop of recurring duty cycles such that when one duty cycle ends another duty cycle begins, each recurring duty cycle comprising an on-cycle in which a fluid flows to and from the cell culture chamber and an off-cycle in which fluid flow is stopped, the off-cycle being longer than the on-cycle; and

memory in communication with the processor, wherein the memory contains one or more calculated duty cycle parameters stored as a set of instructions executable by the processor for operating the one or more pumps on the continuous loop of recurring duty cycles, wherein the set of instructions specify for each recurring duty cycle a duration of an on-cycle, a duration of an off-cycle, and an overall duration of the recurring duty cycle, such that each recurring duty cycle has a same average flow rate.

2. The cell culture system of claim 1, wherein the cell culture system is sized and configured to fit inside an incubator.

3. The cell culture system of claim 1, further comprising a fluid reservoir in fluidic communication with the inlet of the cell culture chamber.

4. The cell culture system of claim 1, wherein, during the on-cycle, the one or more pumps is configured to deliver cell culture medium to the cell culture chamber via the inlet and remove waste products from the cell culture chamber via the outlet.

5. The cell culture system of claim 1, wherein during the on-cycle, the pump forces a flow of fluid to and from the cell culture chamber.

6. The cell culture system of claim 5, wherein the fluid comprises a cell culture medium.

7. The cell culture system of claim 1, wherein the duty cycle has a duration of about 60 seconds.

8. The cell culture system of claim 1, wherein the on-cycle lasts for under 20% of the duration of the duty cycle.

9. The cell culture system of claim 1, wherein the average flow rate is less than 1000 μL of fluid per minute.

10. A method for culturing cells, the method comprising:

providing a cell culture system comprising a cell culture chamber in fluidic communication with one or more pumps, the one or more pumps operably coupled to one or more perfusion fluid reservoirs and configured to pump culture media into and out of the cell culture chamber via an inlet and an outlet disposed on the cell culture chamber;

providing a computer system comprising a processor in communication with the pump, wherein the processor is coupled to non-transitory, computer-readable memory containing instructions executable by the processor to cause the computer system to:

receive as input data comprising a size of the cell culture chamber;

calculate a desired average fluid flow rate that will be introduced into the cell culture chamber;

calculate one or more duty cycle parameters based on the desired average fluid flow rate, a heat output of the system, and a desired cell culture temperature inside an incubator, wherein the calculated duty cycle parameters are stored as a set of instructions executable by the processor for operating the pump; and

operating the pump on a continuous loop of recurring duty cycles such that when one duty cycle ends another duty cycle begins, each recurring duty cycle having a same average flow rate within the range of laminar flow, wherein the duty cycle comprises:

an on-cycle in which a fluid flows to and from the cell culture chamber; and

an off-cycle in which fluid flow is stopped, the off-cycle being longer than the on-cycle, wherein the set of instructions specify for each recurring duty cycle a duration of an on-cycle, a duration of an off-cycle, and an overall duration of the recurring duty cycle.

11. The method of claim 10, wherein the cell culture system is sized and configured to fit inside an incubator.

12. The method of claim 10, further comprising a fluid reservoir in fluidic communication with the inlet of the cell culture chamber.

13. The method of claim 10, wherein operating the pump comprises delivering cell culture medium to the cell culture chamber via the inlet and removing waste products from the cell culture chamber via the outlet.

14. The method of claim 10, wherein during the on-cycle, the pump forces a flow of fluid to and from the cell culture chamber.

15. The method of claim 14, wherein the fluid comprises a cell culture medium.

16. The method of claim 10, wherein the duty cycle has a duration of about 60 seconds.

17. The method of claim 10, wherein the on-cycle lasts for under 20% of the duration of the duty cycle.

18. The method of claim 10, wherein the average flow rate is less than 1000 μL of fluid per minute.

19. The cell culture system of claim 1, wherein the system calculates the one or more duty cycle parameters based on a desired average flow rate, a heat output of the system, and a desired cell culture temperature inside an incubator.

20. The cell culture system of claim 1, wherein the one or more duty cycle parameters comprise one or more of duration of the duty cycle, percentage of time for the on-cycle, and flow rate during the on-cycle.